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IMPACT OF FINANCIAL CRISIS ON SOUNDNESS OF EUROPEAN BANKING SYSTEMS ACCORDING TO THE LEVEL OF FINANCIAL DEVELOPMENT

The consequences of the global financial crisis differ among the EU members, not only because of structural deficiencies accumulated by some of them but also due to the lack of macroprudential supervision and regulatory mechanisms. Using macroprudential indicators issued by the IMF and developing an aggregate financial stability index, this paper examines the ability of these indicators to detect differences in the level of soundness of European banking systems according to the levels of their financial development. The analysis reveals statistically significant differences for the indicators of asset quality, capital adequacy and banking sector profitability. Furthermore, the results show greater financial vulnerability during the crisis in financially more developed countries.

Keywords: financial soundness; banking sector; macroprudential supervision; the European Union.
JEL codes: F33, F36, G28.

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ВПЛИВ ФІНАНСОВОЇ КРИЗИ НА СТІЙКІСТЬ БАНКІВСЬКИХ СИСТЕМ У ЄВРОПІ В ЗАЛЕЖНОСТІ ВІД ЇХ РОЗВИНЕНОСТІ

У статті продемонстровано, що наслідки глобальної фінансової кризи суттєво різняться по країнах ЄС. Це пояснюється структурними особливостями банківських систем, а також характерними рисами макропруденційного нагляду та регулятивної політики окремих країн. Автори використали індикатори, розроблені МВФ, для формування власного комплексного показника фінансової стабільності. Висвітлено, яким чином індикатори МВФ допомагають виявити різницю у ступені стійкості фінансових систем Європи в залежності від їх розвитку. Аналіз даних виявив статистично значущі відмінності для таких показників як якість активів, достатність капіталу та прибутковість банківського сектору. Результати аналізу доводять, що більш розвинені у фінансовому плані економіки виявились більш фінансово вразливими до наслідків кризи.

Ключові слова: фінансова стійкість; банківський сектор; макропруденційний нагляд; Європейський союз.

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ВЛИЯНИЕ ФИНАНСОВОГО КРИЗИСА НА УСТОЙЧИВОСТЬ БАНКОВСКИХ СИСТЕМ В ЕВРОПЕ В ЗАВИСИМОСТИ ОТ ИХ РАЗВИТОСТИ

В статье показано, что последствия глобального финансового кризиса имеют существенные различия в странах ЕС. Это объясняется структурными различиями банковских систем, а также особенностями макропруденциального надзора и регулятивной политики. Авторы использовали индикаторы, разработанные МВФ, для формирования собственного комплексного показателя финансовой стабильности.

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Продемонстрировано, каким образом индикаторы МВФ помогают выявить различия в степени устойчивости банковских систем Европы в зависимости от их развития. Анализ данных выявил статистически существенные различия для таких показателей как качество активов, достаточность капитала и прибыльность банковского сектора. Результаты анализа доказывают, что более развитые в финансовом плане экономики оказались более уязвимыми к последствиям кризиса.

Ключевые слова: финансовая устойчивость; банковский сектор; макропруденциальный надзор; Европейский союз.

1. Introduction. Banking sector stability has attracted increasing attention in recent decades. The relevance of this debate has enhanced with recent disruptions experienced by financial entities in important countries. A valuable lesson from the financial crisis is the requirement of an adequate institutional framework for tracking various sources of systemic risks and exhaustively assessing its consequences for the financial system well in advance. Intensifying the macroprudential approach can reduce systemic risks, decreasing its severe costs.

The IMF carried out an initiative to develop and collect a set of macroprudential measures, which results in the publication of "Financial Soundness Indicators: Compilation Guide" in 2006. Other international agencies have implemented similar initiatives, particularly the Organization for Economic Co-operation and Development (OECD), the Bank for International Settlements (BIS), the European Central Bank (ECB), and others. Nevertheless, the IMF work is arguably the most interesting because it aims to develop international standards for the compilation of macroprudential indicators (Morttinen et al., 2005).

FSIs are the measures that include, apart from aggregate information on banks' balance sheets and income statements, other aggregate indicators of the financial fragility of companies and non-bank financial markets (Sundararajan et al., 2002). Their objective is to compare the financial soundness between countries. The guidelines published by the IMF are divided into two groups (IMF, 2006: 2), one composed of basic indicators identifying the most relevant areas of banking business (capital adequacy, asset quality, profitability, liquidity, and exposure to foreign currency). The rest of the indicators belong to a group of recommendations both for the banking sector and for non-bank financial institutions, non-financial companies, households, financial and real estate markets.

This work analyses the ability of FSIs to detect differences in the level of soundness of European banking systems according to their levels of financial development during the crisis period. We classify the EU countries into two groups by their level of financial development. Subsequently, we assess the degree of the banking sector's financial soundness in 2008–2011 with the assistance of normally used capital adequacy, asset quality, profitability, and liquidity indicators. We conclude by developing an aggregate financial stability index and examining the existence of significant differences depending on the level of financial development.

We will proceed in the following manner: Section 2 presents the review of the related literature. Section 3 outlines the relevant aspects of the methodology used. Sections 4 and 5 develop the main analyses and results. Finally, Section 6 presents the conclusions.

2. Literature Review. Two approaches are used to assess bank risk: the microprudential approach, based on specific variables analysed at the entity level, and the macroprudential approach, which applies micro-aggregated data and financial and macroeconomic information referring to the entire financial system. The latest financial problems have shown the limits of microprudential regulation in identifying systemic vulnerabilities, leading to a shift towards the macroprudential approach (Cheang and Choy, 2011).

Regarding the research on macroprudential FSIs, in the theoretical field, the ECB, IMF, and BIS have published various studies that describe the concepts, compilation methodology, and usage of these indicators. In this context, the most noteworthy works are by Sundararajan et al. (2002), Slack (2003), Morttinen et al. (2005), Agresti et al. (2008), and San Jose and Georgiou (2008).

At the empirical level, the most relevant investigations can be structured into 3 different groups. The first group aims to clarify the macroeconomic determinants of some FSIs (Akhter and Daly, 2009; Babihuga, 2007; Filip, 2009). Another set analyses the capacity of certain FSIs to provide signals anticipating disequilibria in banking. Thus, the work of M. Cihak and K. Schaeck (2010) presents the econometric analysis of the applicability of these ratios in identifying bank problems. Finally, the third group of research focuses on the evolution of the indicators, obtaining warning signals about banking systems' soundness. S. Akhter and K. Daly (2009) consider 3 aspects of financial soundness (capital adequacy, asset quality and profitability), observing their evolution on a global sample of countries. They conclude that FSIs enable a comparative analysis of financial health between countries, despite some methodological and compilation differences. Recently, J. Maudos (2012) has studied the evolution of several FSIs in the Spanish banking sector, comparing them with those in the Eurozone. The results show the weaker Spanish banking sector as an aftermath of the crisis, both in absolute terms and in relation to the euro area, simultaneously reflecting the improvement experienced in solvency ratios.

Regarding the research on financial development, a large body of economic literature supports the premise that long-term economic growth of a country is related to its degree of financial development (Jung, 1986; Levine and Zervos, 1998; Levine, 2004). Financial development is measured by factors such as size, deepness, access and efficiency of the financial system, which includes markets, intermediaries, assets, institutions, and regulation (WEF, 2012). Some of the most commonly used proxy variables are "credit/GDP", "market capitalisation/GDP", and "total capitalisation/GDP" (Maudos and Fernandez de Guevara, 2006). R. Levine and S. Zervos (1993), R. Rajan and L. Zingales (1998), T. Beck (2006), J. Bena and P. Ondko (2012), among others, mention some of these variables as proxies for financial development.

Finally, in the research focused on constructing aggregate financial stability indices, a notable paper by U. Das et al. (2004) uses only two indicators (the capital adequacy ratio and the non-performing loans ratio) developing an index of banking sector resiliency. However, they recognise that it would be ideal to construct an aggregate index that includes all CAMELS variables (Capital adequacy, Asset quality, Management quality, Profitability, Liquidity, and Sensitivity to market risk). N. Cheang and I. Choy (2011) created a financial stability indicator for the banking sector in Macao based on financial vulnerability subindices, regional economic out-

look and financial soundness, with the latter considering capital adequacy, asset quality, liquidity, and profitability indicators. Other research in this direction includes the work of J.W. Van den End (2006) for the financial system of the Netherlands, A. Gersl and J. Hermanek (2008) for Czech Republic, and C.T. Albuлесcu (2010) in Romania.

3. Data and Methodology. We analyse the relationship between the financial soundness and the level of development within the European banking sector using the macroprudential indicators issued by the IMF – considered individually for the main assessment areas and jointly when constructing the aggregate index.

3.1. Sample. The sample includes 25 EU member states from 2008 to 2011. We excluded Denmark and Luxembourg because not all the information for the indicators was available. Following J. Maudos and J. Fernandez de Guevara (2006), we consider "total capitalisation/GDP" as a proxy for the financial development level. This variable is selected to jointly contemplate two important financial development forces: financial intermediaries and financial markets. The proxy is obtained as the sum of "Credit/GDP" and "Capitalisation of listed companies/GDP". "Credit/GDP" is calculated by dividing domestic credit provided by the banking sector by the gross domestic product. The "capitalisation of listed companies" is calculated by using the share price times the number of shares outstanding of domestically incorporated companies listed on the country's stock exchanges at the end of the year. The data were obtained from the World Bank's database "World Development Indicators".

We divided the sample into two groups using the "total capitalisation/GDP". The mean value of the variable is estimated for each year as a benchmark to define the groups of countries with higher (Group 1) and lower development (Group 2). We select this varying cut-off value to take into account the variations in the country's level of financial development throughout the crisis period. Countries with values of total capitalisation/GDP higher than the benchmark are classified into Group 1, and the remaining countries – into Group 2. Table 1 shows the classification procedure.

3.2. Explanatory Variables. We only consider basic indicators for the areas of capital adequacy, asset quality, profitability, and liquidity (Table 2) to obtain a sufficiently representative and stable sample for this period. The information was obtained from the IMF's FSI database.

3.3. Aggregate Financial Soundness Index. Establishing a global measure that would summarise and assess the degree of financial soundness of banking systems has become, in recent years, a challenge for central banks, financial supervisory agencies, and analysts. Although the indices proposed differ from the variables used and from the weights assigned, they do have in common the use of capital adequacy, asset quality, and profitability indicators. The study on the use, compilation and dissemination of macroprudential indicators conducted by the IMF in 2000 demonstrated how all FSI categories were considerably effective. Specifically, the indicators of capital adequacy, asset quality, and profitability were the most useful ones (Sundararajan et al., 2002).

To value the strength of European financial system depending on its level of development during the recent financial crisis, we selected the indicators that demonstrated significant differences between the groups of countries to construct a basic banking sector stability index. The index is an aggregate measure of financial soundness with capital adequacy (RCRWA and RCR1WA), asset quality (NPLTGL), and profitability (ROA and ROE) indicators, based on the equation:

$$Index = \frac{1}{3} \times \frac{(RCRWA + RCR1WA)}{2} - \frac{1}{3} \times NPLTGL + \frac{1}{3} \times \frac{(ROA + ROE)}{2}. \quad (1)$$

Table 1. List of Countries in Each Group

Country	Groups by "total Capitalisation/GDP"			
	2008	2009	2010	2011
BENCHMARK	152.25	174.45	180.56	170.36
Austria	2	2	2	2
Belgium	2	2	2	2
Bulgaria	2	2	2	2
Cyprus	1	1	1	1
Czech Republic	2	2	2	2
Estonia	2	2	2	2
Finland	2	2	2	2
France	1	1	1	1
Germany	1	2	2	2
Greece	2	2	2	2
Hungary	2	2	2	2
Ireland	1	1	1	1
Italy	1	2	2	1
Latvia	2	2	2	2
Lithuania	2	2	2	2
Malta	1	1	1	1
Netherlands	1	1	1	1
Poland	2	2	2	2
Portugal	1	1	1	1
Romania	2	2	2	2
Slovak Republic	2	2	2	2
Slovenia	2	2	2	2
Spain	1	1	1	1
Sweden	1	1	1	1
United Kingdom	1	1	1	1

Table 2. Explanatory Variables of Financial Soundness

CATEGORY	INDICATOR	SYMBOL
CAPITAL ADEQUACY	Regulatory capital to risk-weighted assets	RCRWA
	Regulatory Tier I capital to risk-weighted assets	RC1RWA
	Nonperforming loans net of provisions to capital	NPLNPC
ASSET QUALITY	Nonperforming loans to total gross loans	NPLTGL
EARNINGS AND PROFITABILITY	Return on assets	ROA
	Return on equity	ROE
LIQUIDITY	Liquid assets to total assets	LATA
	Liquid assets to short-term liabilities	LASTL

<http://fsi.imf.org/misc/FSI%20Concepts%20and%20Definitions.pdf> for a more detail explanation.

To calculate the index, before the aggregation all the indicators were normalised to achieve the same variance. The sign (+/-) reflects the influence of each indicator of financial soundness. Based on the indices proposed by U. Das et al. (2004) and N. Cheang and I. Choy (2011), we assign identical weights to all partial categories (1) to give equal importance to each individual area. It is the most popular weighting method used in relevant research (Cheang and Choy, 2011: 41). Furthermore, the IMF has not noted the superiority of any of these categories to analyse financial soundness.

3.4. Assumptions and Contrasts. We examine the influence of the financial crisis on the soundness of European banking systems according to the level of development, contrasting the difference in means between the two groups, by indicator, and with the aggregate index. We use the Student-t statistics after prior verification that the homoscedasticity and normality assumptions are met. In the case of non-compliance with the homoscedasticity assumption (Levene test), the contrast is conducted with the Welch statistics (Montilla and Kromrey, 2010). For the indicators with distributions other than a normal distribution (Shapiro-Wilk test), we employ the non-parametric Mann-Whitney U-test. Additionally, we assess the degree of differences between groups by calculating the "effect size" (*d*), based on the equation:

$$d = \frac{\overline{X_1} - \overline{X_2}}{\sigma}, \tag{2}$$

where $\overline{X_1}$ – mean value of the indicator/index in Group 1; $\overline{X_2}$ – mean value of the indicator/index in Group 2; σ – combined standard deviation based on the Cohen's equation (1977):

$$\sigma = \sqrt{\frac{N_1 \times \sigma_1^2 + N_2 \times \sigma_2^2}{N_1 + N_2}}, \tag{3}$$

where N_1 – number of countries from Group 1; N_2 – number of countries from Group 2; σ_1^2 – variance of the indicator/index in Group 1; σ_2^2 – variance of the indicator/index in Group 2.

4. Results by Indicator/Area. The analysis is conducted by the assessment area for each individual year. The results obtained for various indicators of financial soundness and the position held by each country in each of the areas are shown in Tables 3 and 4, respectively. In addition, we develop the same contrast for the complete period 2008–2011 to determine the stability of differences over time (Table 5).

Table 3. Individual Indicator Results by Year

	2008		2009		2010		2011	
	Higher FD	Lower FD	Higher FD	Lower FD	Higher FD	Lower FD	Higher FD	Lower FD
RCRWA								
Mean value	11.335	12.918	12.876	14.444	12.954	14.992	12.912	14.971
Median value	11.295	11.990	12.699	13.928	12.671	14.617	12.736	14.867
SD	1.238	2.435	1.363	2.688	1.624	2.764	2.942	2.349
Levene's test	3.344*		1.456		1.215		0.071	
T-test/Welch's test	4.451**		-1.6259051		-2.013*		-1.941*	
Mann-Whitney U test	44*		46		38*		39**	
d Cohen	-0.7919		-0.6816		-0.8433		-0.7909	
# of Observations	11	14	9	16	9	16	10	15
RC1RWA								
Mean value	8.482	10.632	10.159	11.809	10.678	12.386	10.893	12.842
Median value	8.480	10.718	10.114	11.583	10.825	11.728	10.688	12.266
SD	1.067	1.349	1.303	2.009	1.486	2.273	2.665	2.212
Levene's test	0.689		1.885		2.216		0.088	
T-test/Welch's test	-4.324***		-2.207**		-2.015*		-1.99*	
Mann-Whitney U test	18***		36**		37**		35**	
d Cohen	-1.7442		-0.9235		-0.8433		-0.8111	
# of Observations	11	14	9	16	9	16	10	15
NPLNPC								
Mean value	20.069	14.485	30.406	35.286	31.772	36.555	43.169	36.645
Median value	16.120	11.500	19.287	24.976	20.628	26.825	40.408	24.544

Continuation of Table 3

	2008		2009		2010		2011	
	Higher FD	Lower FD	Higher FD	Lower FD	Higher FD	Lower FD	Higher FD	Lower FD
SD	12.442	11.232	20.636	34.847	19.581	29.257	25.240	27.442
Levene's test	0.760		0.644		0.933		0.410	
T-test/Welch's test	1.177		-0.382		-0.437		0.601	
Mann-Whitney <i>U</i> test	54		67		71		64	
<i>d</i> Cohen	0.4741		-0.1600		-0.1827		0.2454	
# of Observations	11	14	9	16	9	16	10	15
<i>NPLTGL</i>								
Mean value	3.004	2.987	4.555	7.301	5.011	8.704	6.933	9.302
Median value	2.819	2.747	4.121	5.791	4.668	8.214	6.667	8.714
SD	1.703	1.273	2.435	5.475	2.876	5.569	4.626	5.661
Levene's test	0.732		1.792		2.719		3.538*	
T-test/Welch's test	0.028		-1.413		-1.836*		1.267	
Mann-Whitney <i>U</i> test	70		41		38*		55	
<i>d</i> Cohen	0.0116		-0.5998		-0.7786		-0.4509	
# of Observations	11	13	9	15	9	15	10	14
<i>ROA</i>								
Mean value	0.193	0.882	0.235	-0.295	0.146	0.268	-0.348	0.565
Median value	0.328	1.108	0.352	0.280	0.530	0.359	0.084	0.497
SD	0.558	0.820	0.777	1.776	1.165	0.746	1.541	1.203
Levene's test	0.595		3.575*		0.378		0.148	
T-test/Welch's test	-2.383**		1.065		-0.320		-0.304	
Mann-Whitney <i>U</i> test	29***		65		60.500		53.500	
<i>d</i> Cohen	-0.9618		0.3547		-0.1325		-0.6772	
# of Observations	11	14	9	16	9	16	10	15
<i>ROE</i>								
Mean value	2.053	9.898	3.413	-2.773	2.294	4.179	-4.721	6.428
Median value	4.902	13.624	7.276	4.507	7.995	5.726	1.755	5.739
SD	13.102	14.349	15.689	22.814	21.860	9.244	25.085	13.520
Levene's test	0.000		1.013		1.588		1.370	
T-test/Welch's test	-1.409		0.720		-0.304		-1.444	
Mann-Whitney <i>U</i> test	40**		57		58		56	
<i>d</i> Cohen	-0.5678		0.3012		-0.1252		-0.5865	
# of Observations	11	14	9	16	9	16	10	15
<i>LATA</i>								
Mean value	29.574	24.142	26.482	28.900	26.428	27.680	24.215	28.207
Median value	25.985	22.147	22.272	26.134	24.505	23.453	23.519	29.358
SD	13.030	14.031	10.648	14.199	8.291	13.058	8.754	12.300
Levene's test	0.000		0.748		1.069		1.056	
T-test/Welch's test	0.895		-0.399		-0.231		-0.768	
Mann-Whitney <i>U</i> test	42		45		52		39	
<i>d</i> Cohen	0.3972		0.1835		-0.1065		-0.3534	
# of Observations	8	14	7	15	7	15	7	15
<i>LASTL</i>								
Mean value	85.046	59.651	77.778	61.863	73.635	60.205	72.252	63.472
Median value	57.077	45.415	51.154	57.133	55.257	50.107	55.859	53.596
SD	54.231	55.768	52.820	37.317	48.872	37.429	50.008	36.244
Levene's test	0.423		0.612		0.234		0.405	
T-test/Welch's test	1.024		0.803		0.701		0.462	
Mann-Whitney <i>U</i> test	34		36		37		42.000	
<i>d</i> Cohen	0.4602		0.3692		0.3229		0.2123	
# of Observations	8	13	7	14	7	14	7	14

Note: *** – significant at the 1% level; ** – significant at the 5% level; * – significant at the 10% level.

Table 4. Ranking of the EU countries by individual indicators, by year

Countries	CAPITAL ADEQUACY				ASSET QUALITY				PROFITABILITY				LIQUIDITY																				
	RCRWA		RCIRWA		NPLNPC		NPLTGL		ROA		ROE		LATA		LAST																		
	2008	2009	2010	2011	2008	2009	2010	2011	2008	2009	2010	2011	2008	2009	2010	2011																	
Austria	8	4	6	7	15	13	11	12	2	2	2	2	20	19	13	15	20	19	12	15	9	10	12	11	7	7	8	8					
Belgium	2	2	3	4	5	2	4	4	9	5	8	3	3	4	5	25	21	11	16	25	21	8	17	8	7	6	5	6	5				
Bulgaria	3	3	3	4	5	2	3	3	1	8	14	15	9	17	22	22	1	3	5	8	3	6	13	11	15	18	16	18	20	19	19		
Cyprus	20	21	19	25	21	20	16	25	16	14	15	25	18	10	13	15	9	4	8	25	8	3	7	25	6	7	14	11	12	15	18		
Czech Republic	14	10	7	9	6	6	5	5	14	13	12	11	12	11	12	10	8	1	1	6	1	1	1	3	10	9	8	6	8	7	7		
Estonia	1	1	1	2	1	1	1	1	17	15	13	10	7	13	11	8	5	23	15	1	10	22	16	1	20	19	20	19	20	21	21	21	
Finland	5	9	11	12	2	3	6	6	2	1	1	1	n.a.	n.a.	n.a.	11	7	10	11	13	5	9	10	22	22	22	22	n.a.	n.a.	n.a.	n.a.		
France	21	19	18	18	20	17	19	17	10	12	9	9	14	7	6	6	19	14	7	18	11	6	8	3	5	2	2	3	4	5	6		
Germany	6	6	4	6	12	14	10	11	20	18	16	13	16	5	4	22	16	14	10	22	14	10	9	2	2	3	3	4	2	3	3		
Greece	24	22	20	23	19	12	15	20	19	17	17	22	21	19	17	21	10	11	20	24	12	13	20	24	5	3	5	6	10	11	12	13	
Hungary	9	11	14	13	9	9	14	15	15	16	19	18	17	18	18	6	6	19	20	6	8	19	19	11	8	9	9	12	9	11	11		
Ireland	10	16	10	1	14	19	13	2	18	23	23	19	6	22	20	23	21	22	25	23	21	23	25	23	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.		
Italy	22	24	21	19	24	24	23	22	23	22	22	20	24	21	19	16	16	13	16	21	17	15	15	22	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.		
Latvia	19	12	12	5	10	15	18	7	13	24	24	23	8	23	23	19	18	24	24	12	19	24	24	12	21	13	14	7	21	17	20	9	
Lithuania	13	15	9	11	16	23	17	10	25	25	25	24	23	24	24	24	7	25	23	2	9	25	23	4	14	12	13	10	17	18	17	16	
Malta	15	13	16	14	17	18	22	21	24	20	21	17	22	16	15	13	17	2	3	4	15	2	2	2	12	14	10	13	14	14	14	14	
Netherlands	11	5	13	15	13	7	9	14	22	21	18	16	4	4	3	3	24	20	17	17	24	20	17	16	13	11	11	12	2	1	1	1	
Poland	17	14	15	17	8	8	8	16	6	5	4	4	15	9	9	9	3	5	4	5	2	4	4	5	17	17	18	17	19	19	18	20	
Portugal	25	25	25	24	25	25	25	24	11	11	11	11	14	19	12	10	14	15	10	12	19	16	10	14	20	19	21	19	20	8	5	4	4
Romania	4	8	10	3	4	4	13	12	3	6	7	11	20	21	20	2	15	21	18	4	16	21	18	4	1	1	1	1	1	1	2	2	
Slovak Republic	18	18	17	16	7	11	12	9	3	6	7	5	10	14	14	11	4	9	2	3	7	12	5	7	1	4	4	4	9	10	9	12	
Slovenia	12	23	24	21	18	22	24	23	21	19	20	21	20	15	16	17	14	17	22	22	14	18	22	21	18	20	21	21	16	16	13	15	
Spain	16	20	23	20	22	21	21	19	9	10	10	12	13	8	8	12	12	8	9	13	11	7	11	13	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	
Sweden	23	17	22	22	23	16	20	18	5	4	3	3	1	1	1	1	13	12	6	9	5	9	3	6	16	15	17	15	13	13	10	10	
United Kingdom	7	7	5	8	11	10	7	8	8	7	8	6	2	6	7	7	23	18	18	14	23	17	18	14	7	16	15	18	15	16	17		

Note: The table compiles the position of each country in each period and for each of the individual indicators analysed.

Table 5. Individual Indicator Results for the Period 2008–2011

	Higher FDL	Lower FDL		Higher FDL	Lower FDL
RCRWA			RC1RWA		
Mean value	12.469	14.367	Mean value	9.994	11.944
Median value	12.405	13.972	Median value	9.610	11.721
SD	1.980	2.641	SD	1.948	2.121
Levene's test	3.238*		Levene's test	0.493	
T-test/Welch's test	16.773***		T-test/Welch's test	-4.629***	
Mann-Whitney <i>U</i> test	667***		Mann-Whitney <i>U</i> test	565***	
<i>d</i> Cohen	-0.7892		<i>d</i> Cohen	-0.9488	
# of Observations	39	61	# of Observations	39	61
NPLNPC			NPLTGL		
Mean value	31.078	31.179	Mean value	4.833	7.178
Median value	21.911	21.900	Median value	3.962	5.293
SD	20.875	28.378	SD	3.313	5.373
Levene's test	1.583		Levene's test	9.263***	
T-test/Welch's test	-0.019		T-test/Welch's test	6.98***	
Mann-Whitney <i>U</i> test	1051		Mann-Whitney <i>U</i> test	848**	
<i>d</i> Cohen	-0.0039		<i>d</i> Cohen	-0.5046	
# of Observations	39	61	# of Observations	39	57
ROA			ROE		
Mean value	0.053	0.334	Mean value	0.686	4.221
Median value	0.328	0.492	Median value	5.611	7.148
SD	1.056	1.265	SD	18.901	16.141
Levene's test	0.634		Levene's test	0.449	
T-test/Welch's test	-1.154		T-test/Welch's test	-0.999	
Mann-Whitney <i>U</i> test	954.5*		Mann-Whitney <i>U</i> test	1066	
<i>d</i> Cohen	-0.2366		<i>d</i> Cohen	-0.2047	
# of Observations	39	61	# of Observations	39	61
LATA			LASTL		
Mean value	26.775	28.798	Mean value	77.449	61.328
Median value	23.519	26.134	Median value	55.257	52.858
SD	10.090	12.335	SD	49.068	41.014
Levene's test	1.466		Levene's test	1.818	
T-test/Welch's test	-0.183		T-test/Welch's test	1.599	
Mann-Whitney <i>U</i> test	837		Mann-Whitney <i>U</i> test	606**	
<i>d</i> Cohen	-0.1743		<i>d</i> Cohen	-0.3667	
# of Observations	29	55	# of Observations	29	55

Note: *** – significant at the 1% level; ** – significant at the 5% level; * – significant at the 10% level.

4.1. Capital Adequacy. This assessment area demonstrates the robustness of financial institutions in resisting shocks to their balance sheets and is directly linked to the capacity to absorb sudden losses. We analyse the behaviour of the indicators proposed by the IMF: "Regulatory capital to risk-weighted assets" (RCRWA), "Regulatory Tier 1 capital to risk-weighted assets" (RC1RWA), and "Non-performing loans net of provisions to capital" (NPLNPC). They are calculated according to BIS regulations. Regulatory capital is composed of the elements grouped in two categories ("tiers"). Tier 1 capital only includes the permanent share capital held by shareholders and declared reserves, whereas Tier 2 comprises non-declared reserves, revaluation reserves, generic provisions/general reserves for doubtful loans, hybrid instruments of debt/capital, and subordinated term debt.

The RCRWA and RC1RWA indicators show the same trend, with the former being higher, as is the normal case. In the countries with a higher level of financial

development, the difference between the indicators is smaller due to higher proportions of Tier I capital in regulatory capital caused by the improved availability and capital quality in the entities.

The results show statistically significant differences in the first two indicators of capital adequacy, indicating a relationship between the level of financial development and capital adequacy of banking systems, with the latter higher in less financially developed systems due to the measures adopted to reinforce banking systems capitalisation in these countries – with Estonia, Belgium, and Bulgaria best positioned among the EU countries. The "effect size" is the evidence of the differences magnitude. The contrasts for the complete period 2008–2011 also show significant differences for these indicators, denoting a stable influence over time of the financial development level in capital adequacy of the banking sector.

For the indicator NPLNPC, the results are unclear, perhaps due to its complex nature, which combines magnitude aspects of asset quality and capital adequacy. The contrasts for the entire period do not show significant differences for this indicator.

4.2. Asset Quality. Undoubtedly, asset quality has been one of the aspects of the banking sector that has been hardest hit by the crisis (Maudos, 2012). Obtained through the default rate (NPLTGL), a lower asset quality is indicated when the ratio is higher. The mean value of the indicator has been higher in less developed countries in all years except 2008, indicating a lower quality of assets.

Sweden is noteworthy (occupying the first place), and the Netherlands holds the first place among more developed countries, followed by Austria and Belgium in the less developed group. The countries with the highest default rates (i.e., lower asset quality) are Lithuania, Latvia, and Ireland.

The Student-t test by year reveals insufficient evidence to reject the hypothesis, except for 2010. For the rest of the years studied, there was no statistical significance in the asset quality difference according to the level of financial development. This result could be due to the reduced sample size by year, which causes the tests to fail to detect significant differences if they have a low magnitude. The "effect size" confirms that the magnitude of the difference was only high in 2010. When we developed the contrasts for the complete period 2008–2011, the results show stable statistically significant differences in asset quality of countries with different levels of financial development.

4.3. Profitability. We examine bank profitability based on "Return on assets" (ROA) and "Return on equity" (ROE), two useful measures of the degree of efficiency of deposit takers in using assets and capital, respectively. Both measures evolve in a similar manner. The contrasts conducted by individual years show statistically significant differences only in 2008. The tests developed for the complete period do not reveal significant differences between the profitability of the groups of countries with different levels of financial development.

Regarding the values of these measures by country, the consequences of the financial crisis on bank profitability are evident in both groups. Nevertheless, Czech Republic and Estonia occupy the first place with Malta.

4.4. Liquidity. The IMF proposes the two main liquidity indicators: "liquid assets to total assets" (LATA) and "liquid assets to short term liabilities" (LASTL), both reflecting the capacity of the banking system to withstand shocks. The former measu-

res the available liquidity for expected and unexpected money demands, whereas the latter determines the mismatch between assets and liabilities and indicates up to which level deposit makers can withstand fund withdrawals without facing liquidity problems.

The tests for equal means do not indicate that liquidity differences between both groups of countries are statistically significant, which may be due to the low magnitude of these differences, as shown in the "effect size" results. Nevertheless, the available information for making conclusions on these two indicators are not available for important countries (Spain, Italy, Ireland, and Finland).

5. Aggregate Financial Stability Index. The results in Table 6 present disparate trends, reflecting two different behaviour patterns. For the countries with higher development level, financial soundness of the banking system suffered major setbacks in 2008, recovered in 2009, and again took a turn for the worse in recent years. In the other group, the greatest decline occurred in 2009, with sustained improvements since that year.

Table 6. Aggregate Index Results

	2008		2009		2010		2011		2008–2011	
	Higher FD	Lower FD	Higher FD	Lower FD	Higher FD	Lower FD	Higher FD	Lower FD	Higher FD	Lower FD
AGGREGATE INDEX										
Mean value	-0.310	0.262	0.048	-0.029	-0.029	0.018	-0.174	0.125	-0.128	0.087
Median value	-0.180	0.338	0.094	0.213	0.103	0.285	0.059	0.254	0.047	0.285
SD	0.453	0.575	0.410	0.864	0.565	0.742	0.713	0.711	0.545	0.724
Levene's test	0.597		2.370		2.538		0.054		2.854*	
T-test/ Welch's test	-2.666**		0.246		-0.163		-1.014		2.754*	
Mann- Whitney	30**		57		59		54		820*	
<i>U test</i> <i>d</i> Cohen	-1.0931		0.1045		-0.0688		-0.4199		-0.3274	
# of Observations	11	13	9	15	9	15	10	14	39	57

Note: *** – significant at the 1% level; ** – significant at the 5% level; * – significant at the 10% level.

The analysis discussed in this work detects significant differences only in 2008; however, we also must consider the magnitude of differences. The "effect size" reveals high magnitude differences in 2008, moderate levels in 2011, and lower levels in 2009 and 2010. This result is possibly due to the small number of individuals. The contrasts do not detect as significant the smaller differences in means, which would be detected as statistically significant with a larger sample. In fact, when the whole period is considered, the contrasts reveal statistically significant differences, with a higher value of the index for less financially developed countries.

The first positions in the ranking (Table 7) are held by the countries from the less developed group (Estonia, Belgium, and Czech Republic). The other extreme is occupied by those countries that have suffered most from the effects of the crisis: Cyprus, Greece, Italy, and Portugal, with Spain maintaining intermediate levels in the aggregate index.

6. Summary and Conclusions. Serious difficulties experienced by the banking systems of various countries due to the crisis demonstrate the importance and neces-

sity of controlling and supervising financial stability and promoting systems that combine micro- and macroprudential elements. This study analyses the relationship between the level of financial development and financial soundness within European banking sector using the macroprudential indicators issued by the IMF.

Table 7. Rankings of the EU countries by the aggregate index

Countries	2008	2009	2010	2011
Austria	9	6	5	6
Belgium	13	3	1	2
Bulgaria	2	1	9	13
Cyprus	16	15	13	24
Czech Republic	5	2	3	3
Estonia	1	4	2	1
Finland	n.a.	n.a.	n.a.	n.a.
France	17	16	12	10
Germany	15	10	4	4
Greece	20	18	19	23
Hungary	8	13	18	19
Ireland	10	22	24	16
Italy	24	21	20	21
Latvia	11	23	23	15
Lithuania	21	24	22	17
Malta	22	12	14	12
Netherlands	19	5	11	11
Poland	4	8	6	9
Portugal	23	20	17	20
Romania	3	11	16	18
Slovak Republic	6	14	10	7
Slovenia	18	19	21	22
Spain	14	17	15	14
Sweden	7	7	7	8
United Kingdom	12	9	8	5

The analysis by individual years reveals statistically significant differences between countries with different levels of financial development for the indicators of asset quality, capital adequacy and profitability of the banking sector, but not for liquidity. The additional contrasts developed for the whole period of 2008–2011 show stable, significant differences only for the asset quality and capital adequacy ratios (NPLTGL, RCRWA, RC1RWA).

Considering our aggregate financial stability index, the statistical contrasts and the "effect size" reveal significant differences in financial soundness between countries with different levels of financial development. In particular, the analysis shows a different pattern in both groups; in countries with higher levels of financial development, the financial soundness of the banking system improved after the first year of the crisis, with declining trends in 2009, whereas in financially less developed countries, the financial soundness has experienced progressive improvement after the decline suffered in 2009.

In conclusion, this study confirms the ability of some FSIs to detect differences in the level of soundness of European banking systems, depending on levels of their financial development. Furthermore, the results reveal that more financially developed countries have been more vulnerable to the crisis.

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